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CURRENT PROBLEMS IN RESEARCH

New World Prehistory

The main outlines of the pre-Columbian past are only beginning to emerge.

Gordon R. Willey

The prehistory of the New World is so multifaceted and complex that synthesis demands not only compression but rigorous selection. What strands of human activity can be followed most easily through the maze of the past? Which elements are the significant ones? These are always troublesome questions for the archeologist, and in the present case they are made more so by the tremendous range of space and time and by the quantity and quality of the data with which we are dealing. It is difficult to fix consistently upon criteria of comparison. The best we can do is to adhere to those universal themes of man's existence that leave their mark in or upon the earth: technology, environmental adaptation, subsistence, and settlement. These were not necessarily determinative of the form and elaboration of other aspects of man's life, but they provide a background and a base which is necessary to the understanding of societies and cultures in pre-Columbian America.

Major Problems in New World Archeology

Before beginning this account of New World prehistory it will be well to review some of the major problems confronting the American archeologist, for it will be evident that the tentative conclusions which I have reached about these problems give the outline and structure to the present article. They are problems not unlike those of Old World prehistory (*1, 2*) in that they are concerned with the great changes in man's adaptations to his natural and social environments.

Most briefly, and in approximate chronological order, these problems are as follows.

1) Who were the earliest inhabitants of the New World? Were they food gatherers comparable in their simple subsistence technology to the peoples of the Old World lower and middle Paleolithic?

2) Where and at what time did the American big-game-hunting specialization of the Pleistocene arise? What were its relationships to the possible earlier food gatherers mentioned above? What were its relationships to the big-game-hunting tradition of the Old World? What happened to the pattern?

3) What were the origins and relationships of the specialized food-collecting subsistence patterns of the post-Pleistocene? Did Asiatic diffusions and migrations play a part in these developments, especially in the Arctic and Boreal zones?

4) Where and when were food plants first domesticated in the New World, and what was the effect of this on society and culture?

5) What is the history of pottery in the New World?

6) At what period and in what regions did sedentary village life based upon farming arise in the New World, and what was the history of the spread of this pattern in native America?

7) What was the nature of sedentary village life in the New World in those areas or regions where plant cultivation was poorly developed or lacking, and when did it occur? To what extent were such cultures and societies dependent upon the diffusion of ideas and elements from the village-farming pattern?

8) When and how did the native civilizations of Nuclear America come into being? What were their relationships within the Nuclear sphere? What were their relationships to non-Nuclear America?

In the statement of these problems and in the discussion that follows, certain terminology is used that needs explanation. This terminology also relates to the three diagrammatic charts (Figs. 1–3) which summarize New World prehistory in broad eras or stages of subsistence technology (earlier chronological ranges) or settlement types (later chronological ranges). The term *food gathering* is applied to subsistence patterns where the gathering of wild plant foods or the hunting of animal life lacked regional specialization or technological diversification. This usage follows that of Braidwood in Old World archeology (*3*). *Food collecting*, in contradistinction, implies both specialization and diversification in the taking and utilization of wild plant and animal foods. The other terms descriptive of types of subsistence and settlement—*incipient cultivation, village farming, towns and temples, cities*, and a few other special terms of this nature —are defined below.

The geographical arrangements and the designations of the charts deserve a word. Figure 1 is a cross section for an area that runs north and south through the western axis of the hemisphere. The name *Nuclear America* refers to the southern two-thirds of Mexico, all of Central America, and Andean and coastal Colombia, Ecuador, and Peru, with adjacent portions of Bolivia. This was the heartland of native American agriculture and the seat of the two pre-Columbian centers of civilization, one in Middle America (Mexico-Guatemala) and the other in Peru-Bolivia (*4*). There is a column for each of these two centers on the chart, and the column between, headed

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"Intermediate," refers to what I am calling the "Intermediate area" of southern Central America, Colombia, and Ecuador (*5*). To the north of Nuclear America is western North America, divided into the Southwest culture area and the adjacent Great Basin area. Under "Southern South America" are columns headed "South Andes" and "Pampas-Patagonia." Figure 2 is a cross section for an area extending from the Intermediate area of Nuclear America eastward across Venezuela, then southeastward to the Amazon drainage basin and eastern Brazil,

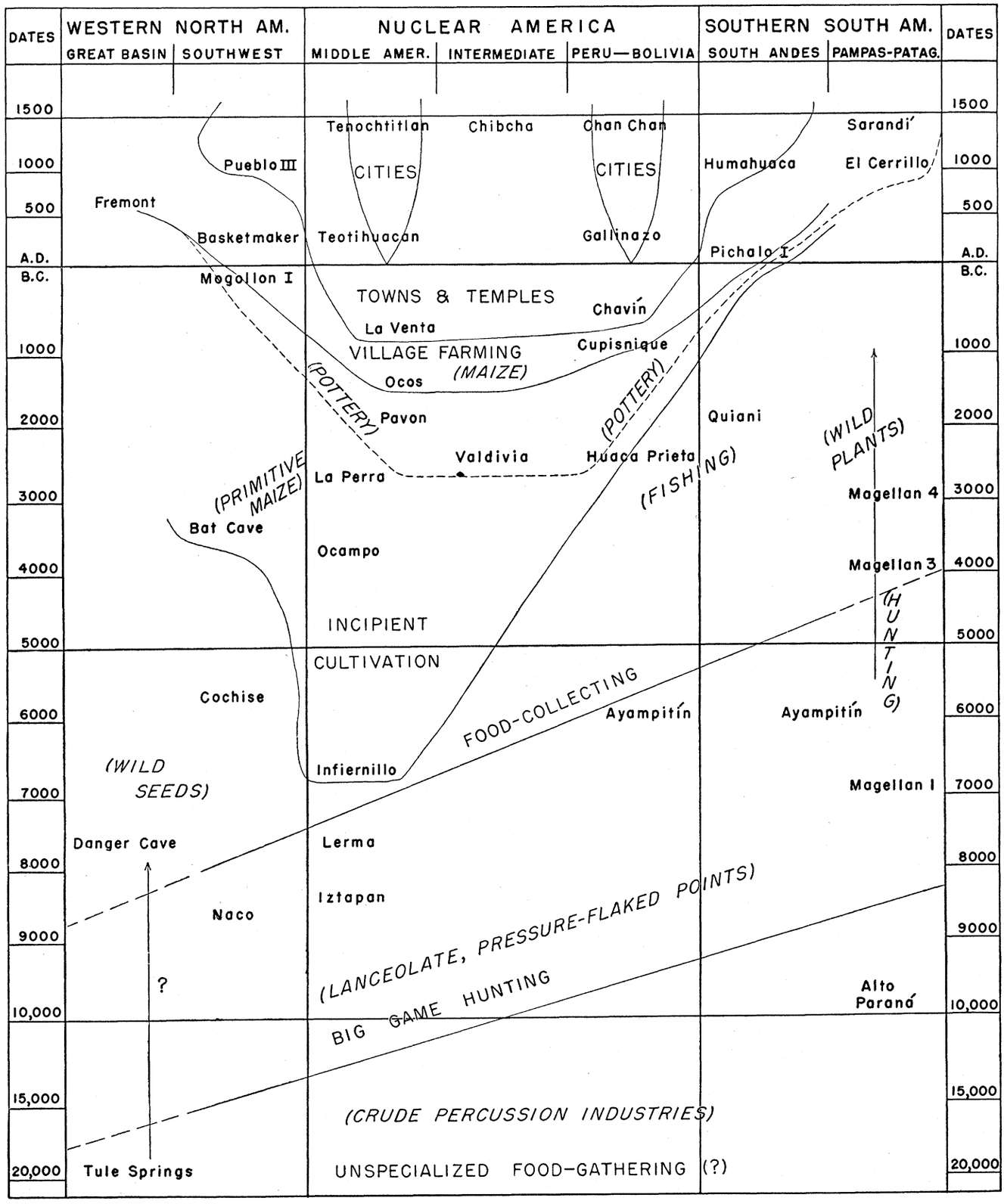

Fig. 1. Subsistence and settlement type levels in native America: cross section for western North America, Nuclear America, and southern South America. The first appearance of pottery is indicated by the dotted line.

and finally south to the Pampas-Patagonia region. In Fig. 3 the "Middle America" column is repeated under "Nuclear America," and the cross section is extended to include the North American eastern woodlands and plains areas. The charts are highly schematic, and only a small number of archeological cultures, or phase names, have been entered in the columns for various areas. (These names appear in small letters.)

The point should be made that the diagonal and curving lines which mark off the major subsistence and settlement types on the charts are not impermeable ones (see *1*, Fig. 6). Influences and traits crossed these lines, frequently moving outward from areas of cultural complexity and intensity into areas of simpler cultures. Such traits were often assimilated by the receiving groups without effecting basic changes in subsistence or settlement. In some instances suspected diffusions of this kind are indicated on the charts by means of arrows.

Pleistocene Food Gathering (?)

There are scattered finds in the Americas which suggest by their typology and chronological position that they may be the remains of early food-gathering societies (*2*, pp. 82–86; *6*). These artifacts include rough, percussion-chipped flint choppers, scrapers, and possibly knives or points, and occasional worked bone splinters. In some places, such as Tule Springs, Nevada, or Friesenhahn Cave, Texas, these crude weapons and tools have been found associated with the bones of extinct Pleistocene mammals, so it is likely that some hunting, even of large game, was practiced (*7*, pp. 197, 218). In general, however, the technological aspects of the implements show a lack of specialization toward hunting or toward any other particular means of obtaining food. In this the artifacts, and the inferences made from them, are analogous to those for the food-gathering cultures of the Old World lower and middle Paleolithic (*8*).

In age and geological placement, such putative early food gatherers in the Americas are not, however, comparable to those of Asia or any part of the Old World. At Tule Springs, a radiocarbon date (22,000 B.C.) indicates a context in the early substages of the Wisconsin glaciation, but in other localities, such as the lowest levels of Danger Cave, Utah (*7*, pp. 193–195; *9*), or Fishbone Cave, Nevada (*7*, pp. 192–193; *10*), the assemblage can be no older than the final Wisconsin advance. Still other artifact assemblages that suggest an unspecialized food-gathering economy are not satisfactorily dated (*11*).

Pleistocene Big-Game Hunting

Sometime during the last Wisconsin interglacial era, or possibly even earlier, inhabitants of the North American continent entered upon a way of life that was based upon the pursuit and killing

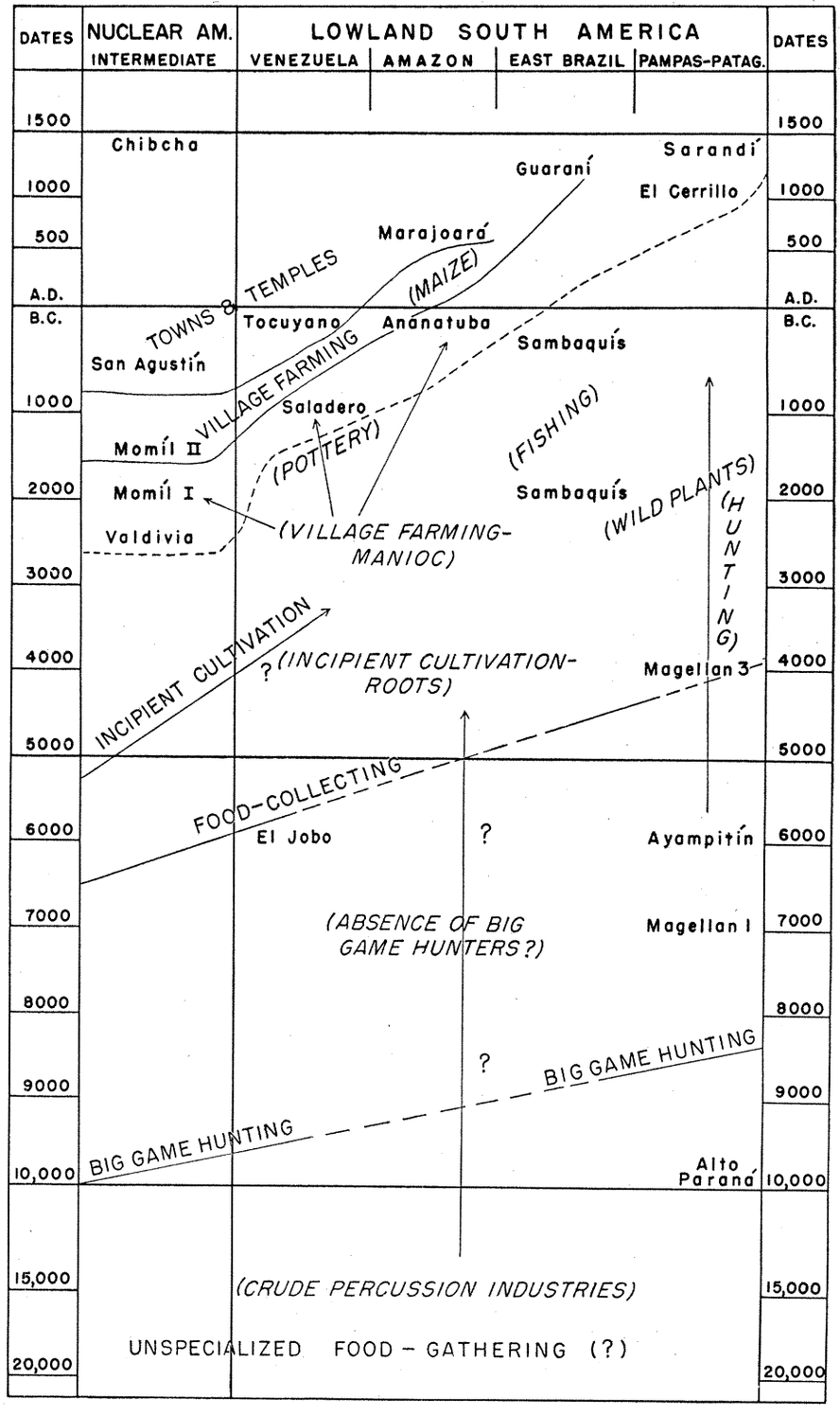

Fig. 2. Subsistence and settlement type levels in native America: cross section for Nuclear America and lowland South America. The first appearance of pottery is indicated by the dotted line.

of the great ice-age mammals, such as the mammoth, the mastodon, the camel, and later the buffalo. The origins of this life pattern are unknown. There are no visible antecedents in the possible earlier food-gathering cultures of the Americas. There is, it is true, a general correspondence between this New World specialized hunting of Pleistocene fauna and what was going on in the Old World in the approximately coeval upper Paleolithic stage; yet even this possibility of a connection with the Old World does not provide a reasonable source for the big-game-hunting complexes of the New World, with their distinctive and highly specialized equipment. Apparently the forms which are most indicative of the American big-game-hunting technology are New World inventions.

The technical equipment associated with big-game hunters in the Americas includes lanceolate projectile points shaped by pressure-flaking. These are frequently distinguished by a channel fluting on both faces of the blade. A variety of skin-scraping tools accompanies the points as they are found in camp sites, "kills," and butchering stations (*7*, pp. 23–90). The best documented of these discoveries come from the North American high plains in eastern New Mexico, Colorado, and Texas, and there are others from southern Arizona southward into Mexico. Some finds, such as those of the lower layer of Sandia Cave, New Mexico, may date back to before 15,000 B.C. (*7*, pp. 85–91; *12*). The Sandia complex is characterized by a lanceolate single-shouldered projectile point. Other discoveries, such as Clovis and Folsom, appear to be later, ranging perhaps, from 15,000 to 7000 B.C. The projectile points of both the Clovis (Fig. 4) and Folsom complexes are of the fluted form (*7*, pp. 23–84). There are also a variety of lanceolate, unfluted points that appear to mark a horizon subsequent to the Folsom. These include the Angostura, Scottsbluff, Plainview, and Eden types (see Fig. 2) (*7*, pp. 107, 118, 138).

The spread of big-game hunting in the Americas took place during, and in the first or second millennium after, the final Wisconsin substage, the Mankato-Valders. The total span of time of this dissemination appears to have been from about 9000 to 5000 B.C. Finds of fluted projectile points throughout the eastern woodlands of North America indicate the former prevalence

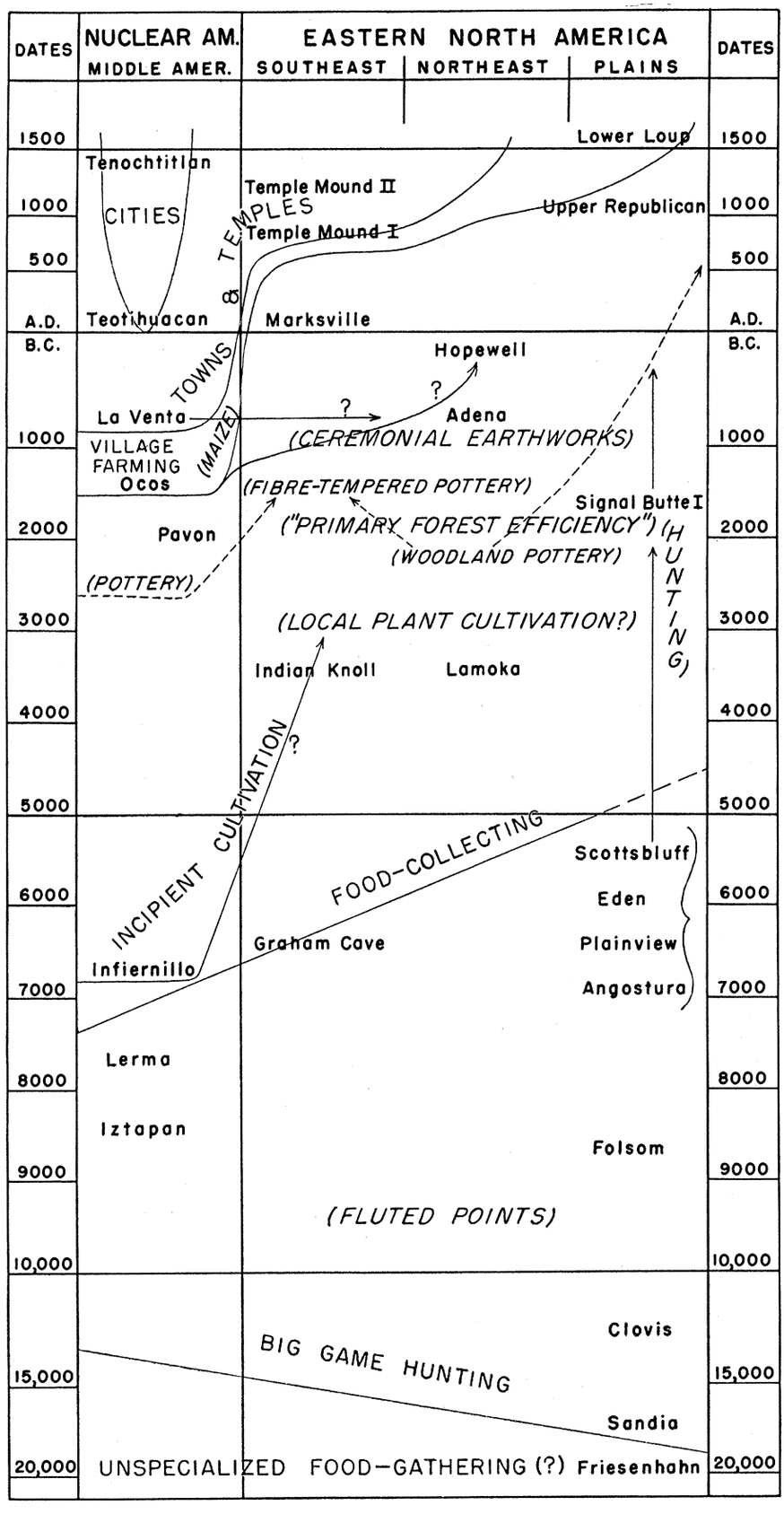

Fig. 3. Subsistence and settlement type levels in native America: cross section for Nuclear America and eastern North America. The first appearance of pottery is indicated by the dotted line.

of the pattern there (*13*). The Iztapan and Lerma remains in central and northeastern Mexico (*14*), the El Jobo points of Venezuela (*15*), the Aympitín industry of the Andes and southern South America (*16*), and the Magellan I culture of the Straits (*17*) give the geographical range of the early big-game-hunting societies.

The fate of the big-game-hunting pattern is better known than its beginnings. After 7000 B.C. and the glacial retreats, there was a shrinkage of the total territory in which the big herbivores could be hunted. The intermontane basins and the range country of western North America became more arid, and a similar climatic shift took place in southern South America. After 5000 B.C., with a still greater increase in warmth and dryness, big-game hunting persisted in the central zones of the old continental grasslands, such as the North American plains and the Argentine pampas. In these areas a modified hunting pattern, based, respectively, on the buffalo and the guanaco, continued into later times. Elsewhere, populations of hunters probably were forced into new environmental situations and new subsistence habits.

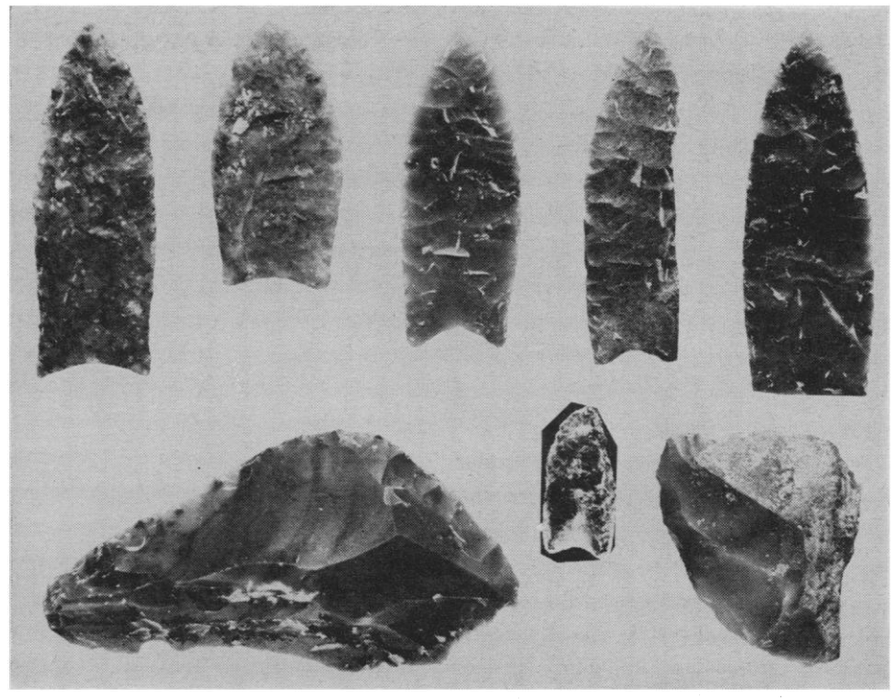

Fig. 4. Clovis type projectile points and associated scrapers from the Lehner site, southern Arizona. These artifacts are comparable to those found at the nearby Naco site. They are representative implements of the North American Pleistocene big-game hunters. [Courtesy Arizona State Museum]

Later Food Collecting and Hunting

These new subsistence patterns can best be described as food collecting. They are differentiated from the possible earlier food-gathering pattern in that they show specialization in the exploitation of regional environments and much more effective technological equipment. Although the taking of game is a means of subsistence in some of these patterns, it is not the old big-game hunting of the Pleistocene. The food collectors, for the most part, developed cultures of greater material wealth, larger communities, and more stable settlements than their predecessors. There were exceptions to this, particularly in areas or regions of severe natural limitations and in the earlier periods of the food-collecting patterns; but on the average, and certainly at the optimum, these generalizations hold true (*18*).

Chronologically, most of the food-collecting patterns had their beginnings in the span of time between about 6000 and 2000 B.C. There were, however, exceptions to this, as in the North American Great Basin, where the specialized collecting of wild seeds was well established as early as 7000 or even 8000 B.C. (*19*). As this is the same general area where clues to the most ancient food gatherers are found, it may be that there is a continuity in the Great Basin from the unspecialized gathering of the early Pleistocene to the later food collecting. According to this interpretation big-game hunting would be only partially represented or would be absent in an intervening sequence position (*20*). This relationship is expressed in Fig. 1.

This possibility of continuities between the North American desert food collectors and earlier resident cultures and populations brings attention to the larger question of the origins of the New World food-collecting patterns and peoples in general. There are three logical possibilities: (i) food-collecting societies and cultures were derivative, arising from the earlier food gatherers; (ii) members of such societies were the descendants of big-game hunters who were forced by the changing climatic conditions that followed the end of the Wisconsin glaciation to make readjustments; or (iii) they were more recent arrivals from the Old World by way of the Bering Strait. It seems quite likely that all three explanations may be useful, according to the particular geographical areas involved, and I have already mentioned the first two. The third explanation, that new arrivals from Asia played a part, is very probably correct insofar as the development of food-collecting cultures in northern North America is concerned. I have in mind particularly the northeastern woodlands, the northwest Pacific coast, and the subarctic and arctic. Elsewhere Asiatic influences were almost certainly of less direct account.

There are several major food-collecting patterns in the New World, and we can only skim over these very briefly. I have referred to what has been called a Desert pattern (*21*). The long depositional histories at Danger Cave, Utah (*9*), Leonard Rock Shelter, Nevada (*7*, pp. 190–192; *22*), and Fort Rock Cave, western Oregon (*7*, p. 184; *23*) are representative, and the basketry and crude milling stones found at these sites testify to a seed-collecting and seed-grinding subsistence. A similar story is recorded in the Cochise culture of southern Arizona-New Mexico (*24*), and there are evidences of this Desert pattern in Mexico as well (*25*).

In the woodlands of eastern North America there is another collecting pattern that shows an adaptation to forest and riverine conditions in hunting, utilization of wild plants, fishing, and catching shellfish. Such sites as the Graham Cave, in Missouri (*26*), suggest that

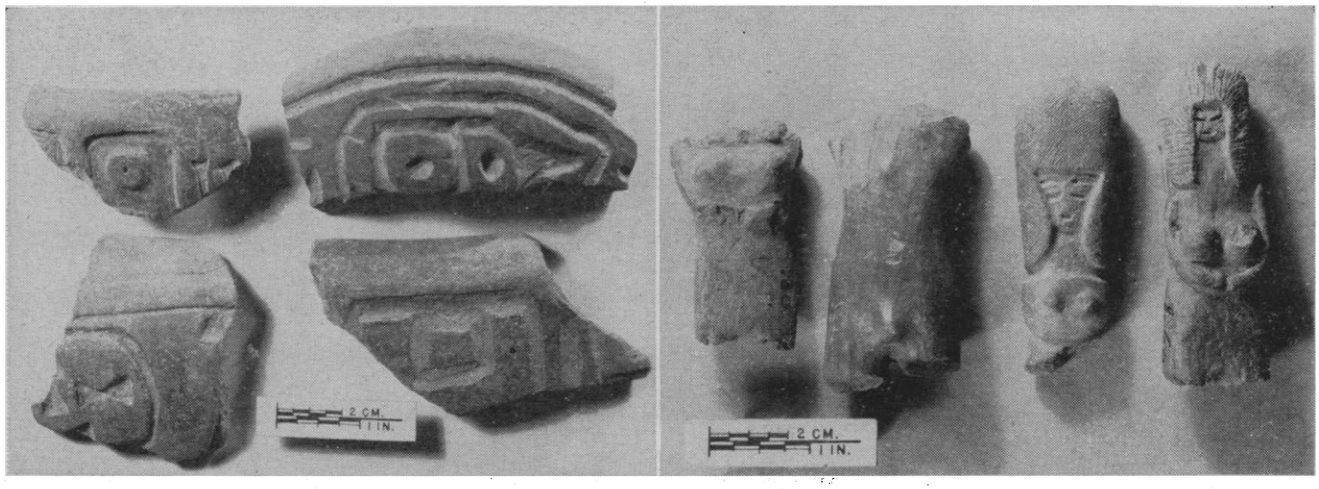

Fig. 5. Valdivia style pottery (left) and figurines (right) from coastal Ecuador. This excised ware and the crudely modeled female figurines may be among the earliest ceramic manufactures of the New World. [Courtesy Emilio Estrada]

there was a transition in the eastern woodlands area, at about 7000 B.C., from big-game hunting to food collecting. In the ensuing millennia these Eastern Woodland collecting cultures, subsumed under the name *Archaic* in much of the literature (*27*), underwent progressive adaptations to regional conditions. By 3000 B.C. they were characterized not only by rough grinding stones and specialized projectile points but by numerous items of polished stone, such as vessels, celts, weights for throwing sticks, and various ornamental or ceremonial objects. The Indian Knoll, Kentucky (*2*, p. 116; *28*), and Lamoka, New York (*2*, pp. 116–117; *29*), phases are typical of their particular regions. Many of the Archaic sites are huge heaps of shells situated along rivers or on the Atlantic coast. Such locations were undoubtedly suitable for a semisedentary, or even sedentary, existence.

Along the Pacific coast of North America there was another food-collecting pattern which paralleled in many ways that of the Eastern Woodlands. Here, by 2000 B.C. if not earlier, semisedentary societies based upon fishing and acorn gathering were established all along the coast from southern Alaska to southern California (*2*, pp. 133–137). In South America there were also ancient fishing societies along the coasts. The Quiani phase (*30*) of northern Chile displays this adjustment. On the Brazilian coast are the huge *sambaquís*, piles of shell refuse containing the skeletons and artifactual remains of food-collecting peoples who lived along these shores probably as much as two millennia before the beginning of the Christian Era (*31*). Coastal shell-mound dwellers are also known from Venezuela at about this same period (*32*, *33*).

I have mentioned that in both the North American and the South American plains there were retentions of big-game-hunting patterns into later times; even these cultures, however, show the result of contact with the neighboring food collectors in their possession of an increasing number of food-grinding implements. This is exemplified in the later North American Plains phases, such as the Signal Butte I (*34*), and by the later phases in the Strait of Magellan sequence and on the Argentine pampas (*35*).

Incipient Cultivation

The change from food collecting to a subsistence based upon plant cultivation was one of the great turning points in human prehistory. This is true of the New World as well as the Old, and there are indications in both hemispheres that this switch-over was not a rapid one, but that it was effected only over a period of experimentation. It is this era of experimental or incipient cultivation in the New World that I now wish to examine (*36*).

In the Americas it would appear that there may be at least four distinct and semi-independent traditions of incipient farming. Two of these are Nuclear American. The northern one, the probable propagator of maize, was located in Middle America and in the adjacent deserts of northern Mexico and the southwestern United States; the southern one had its focus on the Peruvian coast. A third incipient-cultivation tradition centered somewhere in the tropical forests of the Amazon or Orinoco. Its existence is difficult to demonstrate archeologically, but such a tradition is needed to explain the domestication of manioc and other root crops. A fourth, and distinctly lesser, tradition rose in eastern North America in the Mississippi Valley system.

The earliest evidence for incipient cultivation in any of these traditions comes from northern Nuclear America. The region is the northeastern periphery of Middle America, in the semiarid hill country of Tamaulipas. Here, preserved plant remains were taken from the refuse deposits of dry caves. In the Infiernillo phase, dating from 7000 to 5000 B.C., there are traces of domesticated squash *(Cucurbita pepo)* and of possible domesticates of peppers, gourds, and small beans. The cultural context is that of North American desert food collectors. There are, in addition to flint implements, net bags of yucca and maguey cords and woven baskets of a rod-foundation type. In the succeeding Ocampo phase, from about 5000 to 3000 B.C., beans were definitely domesticates. After this, between 3000 and 2000 B.C., a primitive small-eared maize came into the sequence in the La Perra and Flacco phases. R. S. MacNeish, who excavated and studied the Tamaulipas caves, has estimated the composition of food refuse of the La Perra phase to be as follows: 76 percent wild plants, 15 percent animals, and 9 percent cultigens. The La Perra and Flacco artifact inventories are not strikingly different from inventories of the earlier phases, although they demonstrate a somewhat greater variety of manufactures and an increased concern for

seed foods. A few centuries later, at about 1500 B.C., an archeological complex which is representative of fully settled village farming appears in the region. Thus, the Tamaulipas sequence offers a more or less unbroken story of the very slow transition from food collecting supplemented with incipient cultivation to the patterns of established cultivation (*37*).

Early and primitive maize is also found to the north of Tamaulipas, actually outside of Nuclear America, in New Mexico. At Bat Cave, corncobs from refuse of a Cochise-affiliated culture date between 3500 and 2500 B.C. (*38*). This is as early as the La Perra maize, or even earlier.

As yet, neither archeologists nor botanists have been able to determine the exact center of origin for domestication of maize in the New World, and it may be that this important event first took place in northern Middle America and in southwestern North America, where the intensive use of wild seeds in a food-collecting economy in a desert area provided a favorable setting. There remains, nevertheless, the very good possibility that a territory nearer the heart of Nuclear America and more centrally situated for the spread of maize in the hemisphere—an area such as southern Middle America—played this primary role in the cultivation of maize. The great difficulty is, of course, that the archeological record is so uneven, owing to the rarity of sites and environments where such things as plant remains are preserved in the earth. Such findings have not yet been reported in southern Middle America.

Coastal Peru, at the southern end of Nuclear America, provides a rainless climate and splendid conditions for preservation of organic materials in open archeological sites, and it is in Peru that we have glimpsed what appears to be a second tradition of incipient plant cultivation in Nuclear America. At Huaca Prieta, in a great hill of marine shells, sea-urchin spines, ash, and other debris, cultivated squash, peppers, gourds, cotton, and a local bean *(Canavalia)* were found, along with an abundance of wild root plants and fruits. The people who raised and gathered these crops and seafoods lived at Huaca Prieta at least 2000 years before the Christian Era. Whether there was, however indirectly, an exchange of domesticated plants between these early Peruvians and their contemporaries in Middle America is not certain. Such connections could have existed; or the beginnings of cultivation may have been truly independent of each other in these two areas of Nuclear America. Definite connections between early farmers of Middle America and of Peru appear, however, by 700 B.C. with the sudden presence of maize in Peru (*39*). This maize was not, like that at Bat Cave or in the La Perra culture of Tamaulipas, of an extremely primitive kind. It was brought, or it spread, to Peru as a relatively well-developed plant, and it serves as a link to Middle America. We may conclude that Nuclear America possessed, from this time forward, a single major horticultural tradition, but by this time we have also passed beyond the chronological limits of cultivation incipience.

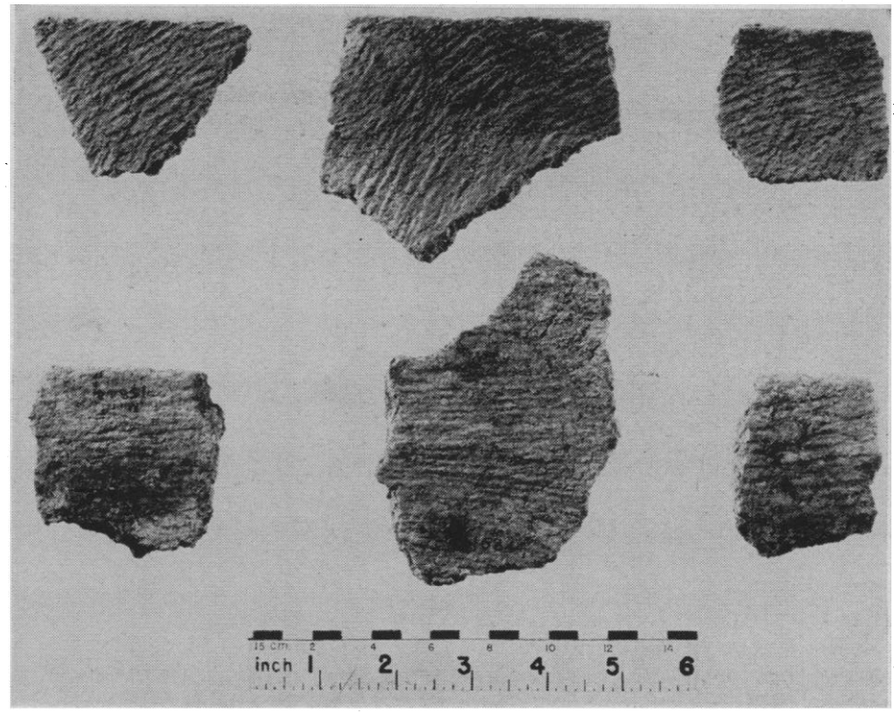

Fig. 6. Early Woodland pottery from New York State. Typical sherds of the Vinette I cord-marked ware, a ceramic that dates back 1000 B.C. or earlier. [Courtesy New York State Museum and Science Service]

An ancient tradition of plant cultivation in the South American tropical forest (*40*) is based upon the presumption that a long period of experimentation was necessary for the domestication of such tropical root crops as bitter and sweet manioc *(Manihot utilissima, M. Api)* and the yam *(Ipomoea batatas)*. It seems reasonably certain that these domesticates date back to before 1000 B.C. in lowland Venezuela. This is inferred from the presence of pottery griddles, of the sort used for cooking manioc cakes in later times, in the Saladero phase at the Orinoco Delta by this date (*32*). Also, the early archeological phase of Momíl I, in Caribbean Colombia, has the pottery manioc griddle (*41*). The dating of Momíl I is debatable, but some of the ceramic traits suggest a date as early as 2000 B.C. Saladero and Momíl I are, however, outside the chronological and developmental range of incipient cultivation patterns. They appear to be village sites based upon the cultivation of root crops, and as such they are comparable to, although historically separate from, village farming based on maize. I shall return to this point farther along. For the present I bring these sites into the discussion because their existence implies centuries, or even millennia, of prior incipient root-crop cultivation in tropical northern South America.

A fourth tradition of incipient cultivation for the New World derives from the cultivation of local plants in the Mississippi Valley by as early as 1000 B.C. These plants include the sunflower, the goosefoot *(Chenopodium)*, and the pumpkin *(Cucurbita pepo)* (*42*). This domestication may have been in response to stimuli from Middle America, or it may have been an entirely independent development. This Eastern Woodland incipient-cultivation tradition was undoubtedly but a minor part of the food-collecting economy for a long time. Just how important it ever became, or how important the early

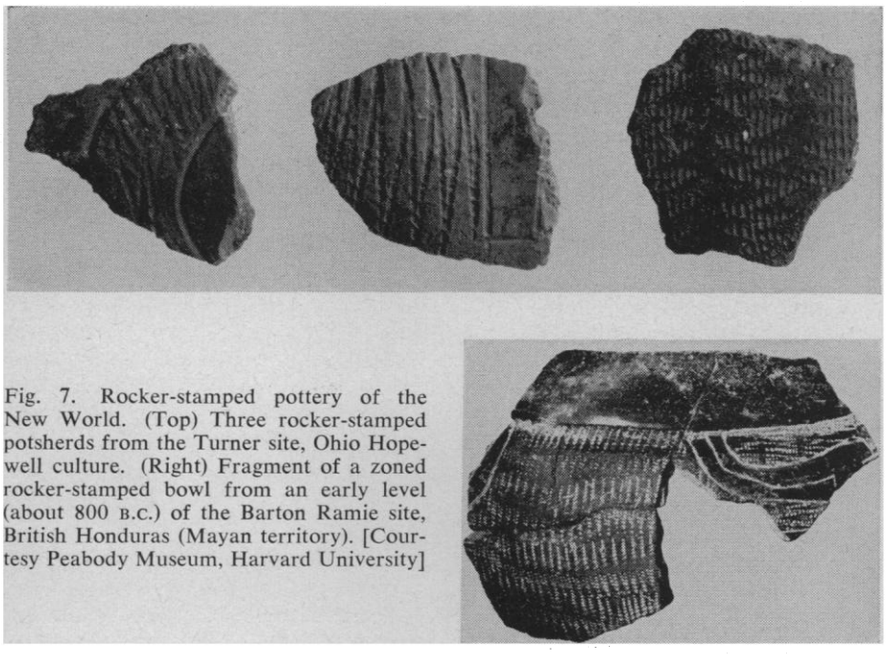

Fig. 7. Rocker-stamped pottery of the New World. (Top) Three rocker-stamped potsherds from the Turner site, Ohio Hopewell culture. (Right) Fragment of a zoned rocker-stamped bowl from an early level (about 800 B.C.) of the Barton Ramie site, British Honduras (Mayan territory). [Courtesy Peabody Museum, Harvard University]

diffusion of maize was to eastern United States cultures of the 1st millennium B.C., are crucial problems in the understanding of the area. I shall return to them later.

Appearance of Pottery

Before taking up the rise of village farming in Nuclear America and its subsequent spread to other parts of the hemisphere, let us review the first appearances of pottery in the New World. Obviously, the line indicating the presence of pottery on the charts is not comparable to the lines indicating type of subsistence or settlement (Figs. 1–3). American archeologists no longer consider pottery to be the inevitable concomitant of agricultural village life, as was the fashion some years ago. Still, ceramics, because of their very ubiquity and durability, are an important datum in many prehistoric sequences. Their presence, while not a necessary functional correlate of farming, at least implies a certain degree of cultural development and sedentary living.

At the present writing there seem to be two pottery traditions for native America. Curiously, the ages of these two pottery traditions—in the broadest sense of that term—may be about the same, 2500 B.C.

One of these pottery traditions, which we shall call the Nuclear American, is believed to be indigenous, but we can be no more specific about its geographic point of origin than to state that this is somewhere in the central latitudes of the New World. Actually, the earliest radiocarbon dates on the Nuclear American pottery tradition come from coastal Ecuador, in the Valdivia phase (Fig. 5), and are from about 2400 to 2500 B.C. (*43*). There are also early dates on pottery generally similar to that of Valdivia from Panama (about 2100 B.C.) (*44*, *45*). Thus, these earliest ceramic datings for Nuclear America are not from Middle America or Peru but from the Intermediate area, and this may be significant in following up origins, although the record is still too incomplete to say for sure. Both the Ecuadorean and the Panamanian early potteries are found in coastal shell-mound sites, and in connection with cultures about whose means of subsistence it is not easy to draw inferences, except to say that full village farming was unlikely. Possibly marine subsistence was supplemented with incipient cultivation, although we have no proof of this. The Valdivia and the Panamanian (Monagrillo) pottery is reasonably well made and fired, the forms are rather simple, and the vessels are decorated with incisions, excisions, punctations, and very simple band painting. These early Ecuadorean and Panamanian styles may be part of a stratum of ancient Nuclear American pottery that underlies both Middle America and Peru. There are some indications that this may be the case, although the oldest pottery so far known in the Middle American and Peruvian areas dates from several centuries later (*46*). In Fig. 1 the interpretation is offered that Nuclear American pottery is oldest in southern Middle America (for this there is as yet no evidence) and in the Intermediate area (for this there is evidence). Whatever the point of origin for pottery in Nuclear America, there is fairly general agreement that the ceramic ideas generated there carried to much of outlying North and South America.

The second major pottery tradition of the Americas is widely recognized by the term *Woodland*. Apparently not indigenous, but derived from northern Asia, it is best known from the eastern woodlands of New York and the Great Lakes region. So far, its presumed long trek from the arctic down through Canada has not been traced (*47*).

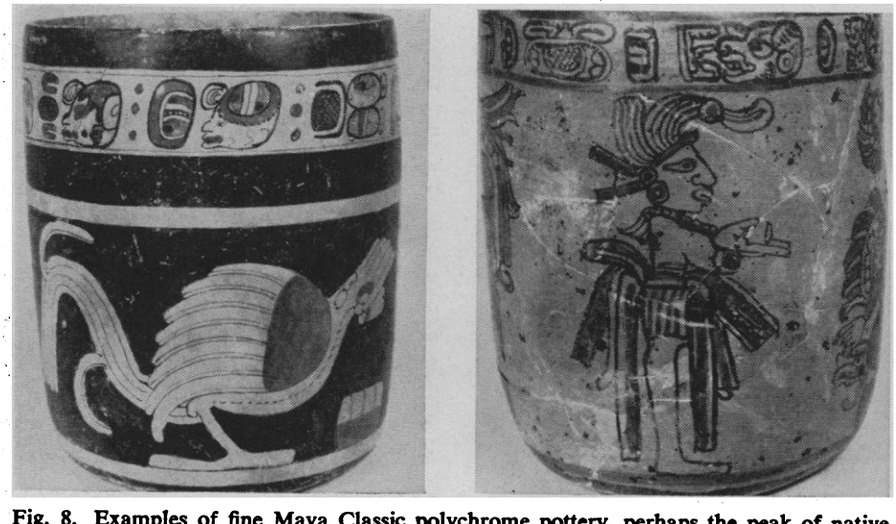

Fig. 8. Examples of fine Maya Classic polychrome pottery, perhaps the peak of native New World ceramic art. Note the bands of hieroglyphs used as decorative borders. [After J. M. Longyear III]

Woodland pottery is generally of simpler design than the early Nuclear American wares. Of an elongated form, it is frequently finished only with cord-marked surfaces (Fig. 6). As already noted, the oldest of this cord-marked pottery in the Americas may go back to 2500 B.C. (*48*). Even if this early dating is not accepted, there is little doubt but that Woodland pottery was well established in eastern North America before 1000 B.C.

In spite of the fact that the Nuclear American and Woodland pottery traditions are so radically different, there are, interestingly, a few similarities. The most notable of these is the technique of rocker-stamping combined with incised zoning of plain surface areas, known in Nuclear America and in the eastern United States (Fig. 7). The distinctive rocker-stamped treatment of pottery was accomplished by impressing the soft, unfired surface of a vessel with either a small straight-edged implement manipulated rocker-fashion or, possibly, with a fine-edged disk used like a roulette. The impressions left on the pottery may be either plain or dentate, and they always have a characteristic "zigzag" appearance. Rocker-stamping is found in the Valdivia phase in Ecuador, and it also occurs at about 1000 B.C. in parts of Middle America and in Peru (*49*). In eastern North America it is not found on the earliest Woodland pottery but is found on vessels which date from just a few centuries before the beginning of the Christian Era. Thus, the Nuclear American rather than the Woodland tradition has chronological priority in this trait in the New World (*50*). Again, as with so many other problems that perplex Americanists we can only refer to this without coming to any conclusions as to the timing and direction of the flows of possible diffusions. Nuclear American and Woodland ceramics may in some way be related, but at the present state of knowledge they appear to have different origins and substantially separate histories (Fig. 8).

Village Farming in Nuclear America

Braidwood and others have stressed the importance in the Old World of the threshold of the village-farming settled community (*1*, refs.; *51*). Although in its beginnings the agricultural village had a subsistence base that was no more adequate, if as ample, as that of some of the food-collecting communities, this base offered the potential in certain Old World localities that led, eventually, to civilization. In the New World a similar development was repeated in Nuclear America.

In the New World the line between incipient cultivation and village farming has been drawn at that theoretical point where village life is, in effect, sustained primarily by cultivated food plants (*52*). In archeology this distinction must be made by an appraisal of the size and stability of a settlement as well as by direct or indirect clues as to the existence of agriculture. In Nuclear America the earliest time for which we can postulate the conditions of village farming is the 2nd millennium B.C. For example, in Middle America in the Tamaulipas sequence the change-over from incipient cultivation to established cultivation takes place at about 1500 B.C. (*53*). Elsewhere in Middle America the known sequences begin with the village-farming stage, as at Early Zacatenco (*54*) (Valley of Mexico), Las Charcas (*55*) (Guatemalan Highlands), Ocos (*56*) (Pacific coast of Guatemala), and Mamom (*57*) (Maya lowlands) (*58*). In Peru the village-farming level is reasonably well defined with the appearance of maize in the Cupisnique phase and the shift of settlements back from the coast to the valley interiors. The date for this event is shortly after 1000 B.C. (*59*); this suggests that the horizon for village farming may have sloped upward in time from Middle America to Peru (Fig. 1). For the Intermediate area, where I have noted the earliest occurrence of pottery in Nuclear America, the threshold of village farming is difficult to spot. In Ecuador, the phases succeeding Valdivia have a different ecological setting, being inland in the river valleys rather than on the immediate shores (*60*). Perhaps, as in Peru, this correlates with the primary economic importance of plant cultivation. In Colombia, the Momíl II phase, which is represented by a stable village site area, is believed to have possessed maize (*41*).

The foregoing discussion carries the implication that village farming was a pattern diffused through Nuclear America from a single area or region. Essentially, this is the point of view expressed in this article. This is not to overlook the possibility that village agricultural stability may have arisen independently in more than one place in the New World. In fact, as I point out below, it apparently did just that in the tropical forests of South America. I am of the opinion, however, that in the Nuclear American zone the maize plant, genetically developed and economically successful, became the vital element in a village-farming way of life that subsequently spread as a complex. For the present, I would hazard the guess that this complex developed in southern Middle America and from there spread northward to Mexico and southward as far as Peru. This was, in a sense, its primary diffusion or spread. Afterward, there were secondary diffusions to other parts of the Americas.

The Village in Non-Nuclear America

These secondary disseminations of the Nuclear American pattern of village farming were responsible for the establishment of similar communities in

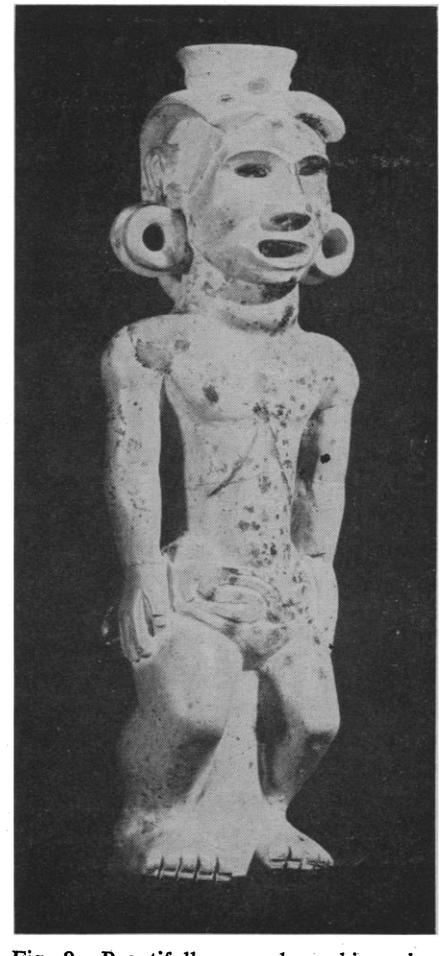

Fig. 9. Beautifully carved smoking pipe showing the skill with which the Adena craftsman worked small objects of stone. [Courtesy Ohio State Museum]

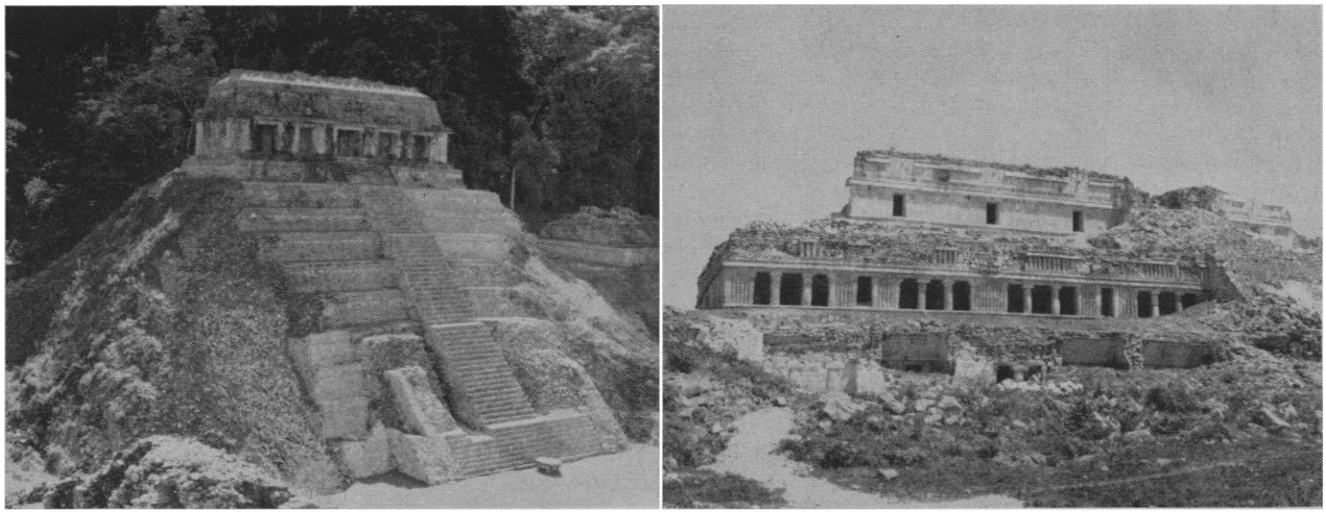

Fig. 10 (Left). A Mayan temple of the Classic period, about A.D. 300 to 900. This is the famed "Temple of the Inscriptions," at the important ceremonial center of Palenque, Chiapas, Mexico. Fig. 11 (Right). A palace-type structure at the Mayan ceremonial center of Sayil, Yucatan, Mexico. This handsome building, now largely in ruins, was built of rubble faced with cut limestone blocks and mortar. It is estimated to have contained about 100 rooms. It was probably constructed, at least in its final phases, between A.D. 600 and 900.

areas such as southwestern North America, the southern Andes, lowland tropical South America, and the eastern woodlands of North America (see Figs. 1–3). This process was relatively simple in southwestern North America and the southern Andes. The agricultural patterns were diffused to, or carried and superimposed upon, peoples with food-collecting economies of limited efficiency. In the Southwest, village farming and ceramics first appear at about the same time in such cultures as the Vahki, the Mogollon I, and the Basketmaker (*2*, pp. 151–155). This was between 200 B.C. and A.D. 300. Moving from the south, the village-farming pattern pushed as far as the Fremont culture (*61*) of the northern periphery of the Southwest. In the southern Andes there is, as yet, no good hint of an early incipient-cultivation tradition, and, apparently, pottery and agriculure arrive at about the same time, integrated as a village-farming complex. This flow of migration or diffusion was from Peru-Bolivia southward. Pichalo I (*30*) of northern Chile marks such an introduction, as do the earliest of the Barreales phases (*62*) in northwest Argentina. The time is about the beginning of the Christian Era. Beyond the southern Andes the village-farming pattern did not diffuse onto the plains of the pampas or Patagonia.

The relationship of Nuclear American village farming to the tropical lowlands of South America was much more complex. There the maize-farming pattern was projected into an area in which village life already existed. This is indicated in Fig. 2 by the entry "Village Farming–Manioc" in the columns headed "Venezuela" and "Amazon." Sedentary village life based upon root-crop farming is estimated to be as old as 2500 B.C. This is a guess, and, if it is correct, these villages are older than the Nuclear American village sustained by maize. Perhaps the estimated date is too early; however, at 2000 and 1000 B.C., respectively (see Fig. 2), we have the villages of Momíl I and Saladero, which, apparently, were supported by root-crop cultivation. It is of interest to note that Momíl I, near the mouth of the Sinú River in Colombia, lies within the axis of Nuclear America; yet it differs from the succeeding Momíl II phase at the same site in being oriented toward manioc rather than maize. This suggests that, in the Intermediate area at least, tropical-forest farming patterns may have preceded farming patterns for maize in Nuclear America.

Relationships between village farming in Nuclear America and in eastern North America are also complicated. It is unlikely that the local incipient-cultivation tradition in eastern North America ever matured into a subsistence pattern that could have supported fully sedentary village life. J. R. Caldwell (*63*) has argued that, in its place, a steadily increasing efficiency in forest collecting and hunting climaxed at about 2000 B.C. in a level of "Primary Forest Efficiency" (see Fig. 3). Such a level, he concludes, offered the same opportunities for population stability and cultural creativity in the eastern woodlands as were offered by village farming. While agreeing with Caldwell that the efflorescence of Adena-Hopewell (about 800 B.C. to A.D. 200) (*64*) (Fig. 9) is the brilliant end product of a mounting cultural intensity in eastern North America that originated in the food-collecting or Archaic societies, I am not yet convinced that plant cultivation did not play an important role in this terminal development. And by plant cultivation I am referring to maize, brought or diffused from Nuclear America. There is, as yet, no good direct evidence of maize associated with either the Adena (*42*) or the contemporary Poverty Point (*65*) culture. Maize is, however, found with Hopewellian cultures (*63*), although it has been assumed that it was of relatively little importance as subsistence at this time. I would argue that the riverine locations of Adena and Hopewell sites, together with the great size and plan of the ceremonial earthworks that mark many of them, make it difficult to infer an adequate subsistence if maize agriculture is ruled out.

To sum up briefly, the amazing cultural florescence of the Eastern Woodlands in the 1st millennium B.C. has not yet been satisfactorily explained. This florescence rests upon a chronologically deep series of Archaic food-collecting cultures which were at least semisedentary, and it contains elements, such as pottery, which are probably of Asiatic derivation and which added to the richness of the Archaic continuum. But the sudden burst of social and cultural energy which marks the Adena culture cannot be interpreted easily

without adding other factors to the equation, and perhaps these missing factors are maize agriculture and other stimuli from Middle America (see Fig. 3).

Village life is, of course, present in native America in the non-Nuclear areas under conditions where plant cultivation may be ruled out entirely. Settled villages developed on the northwest coast of North America, with population supported by the intensive food-collecting economy of the coast and rivers. The same is also true for the coast and interior valleys of California. It is significant, however, that in neither of these areas did aboriginal cultivation ever make much headway, while in eastern North America it became a staple of life in the later pre-Columbian centuries.

Temples, Towns, and Cities

In Nuclear America the town and eventually the city had beginnings in the settled farming village. A centralizing factor in this development was undoubtedly the temple. This earliest form of permanent structure usually had a flat-topped pyramidal mound of earth or rock as a base, and these mound bases of temples are found associated with some, but not all, of the village-farming cultures in Middle America (*66*). At first, the importance of such a mound, and of the temple that stood on it, was probably limited to the immediate village. Sometimes these villages were small, concentrated clusters of dwellings; in other instances the settlement pattern was a dispersed one, with a number of small, hamlet-like units scattered at varying distances from the temple center. Later on, the temple, or temple and palace structures, became the focal point of what might be called a town (*67*) (Figs. 10–12).

In Nuclear America the towns, like their antecedent villages, were either concentrated or dispersed. The former pattern developed in parts of Middle America, such as the Valley of Mexico or the Guatemalan Highlands, and in Peru; the latter was characteristic of the Veracruz-Tabasco lowlands or the Peten-Yucatan jungles of Middle America. In the towns the temple or ceremonial precinct was devoted to religious and governmental matters and to the housing of priests and of rulers and their retainers. The surrounding settlement zone, either scattered or concentrated, grew with increase in the numbers of farmers, artisans, or both. Trade was an important function of these towns.

In Nuclear America the town-and-temple community dates back to 800 B.C., a date that is applicable both to Middle America and to Peru. In the Intermediate area, between these two, town life was certainly pre-Columbian, but its date of origin is difficult to determine because there is a lack of adequate archeological chronologies (*68*).

In lowland South America, town-and temple communities also antedate the Conquest, and it seems likely that these communities were, in part, the result of contact with and stimulus from the Nuclear American axis (*69*). In the southern Andes the tightly planned clusters of rock and adobe buildings of the late archeological periods of northwestern Argentina reflect town and city life in Peru (Fig. 13) and Bolivia (*70*). Similarly, towns of the pre-

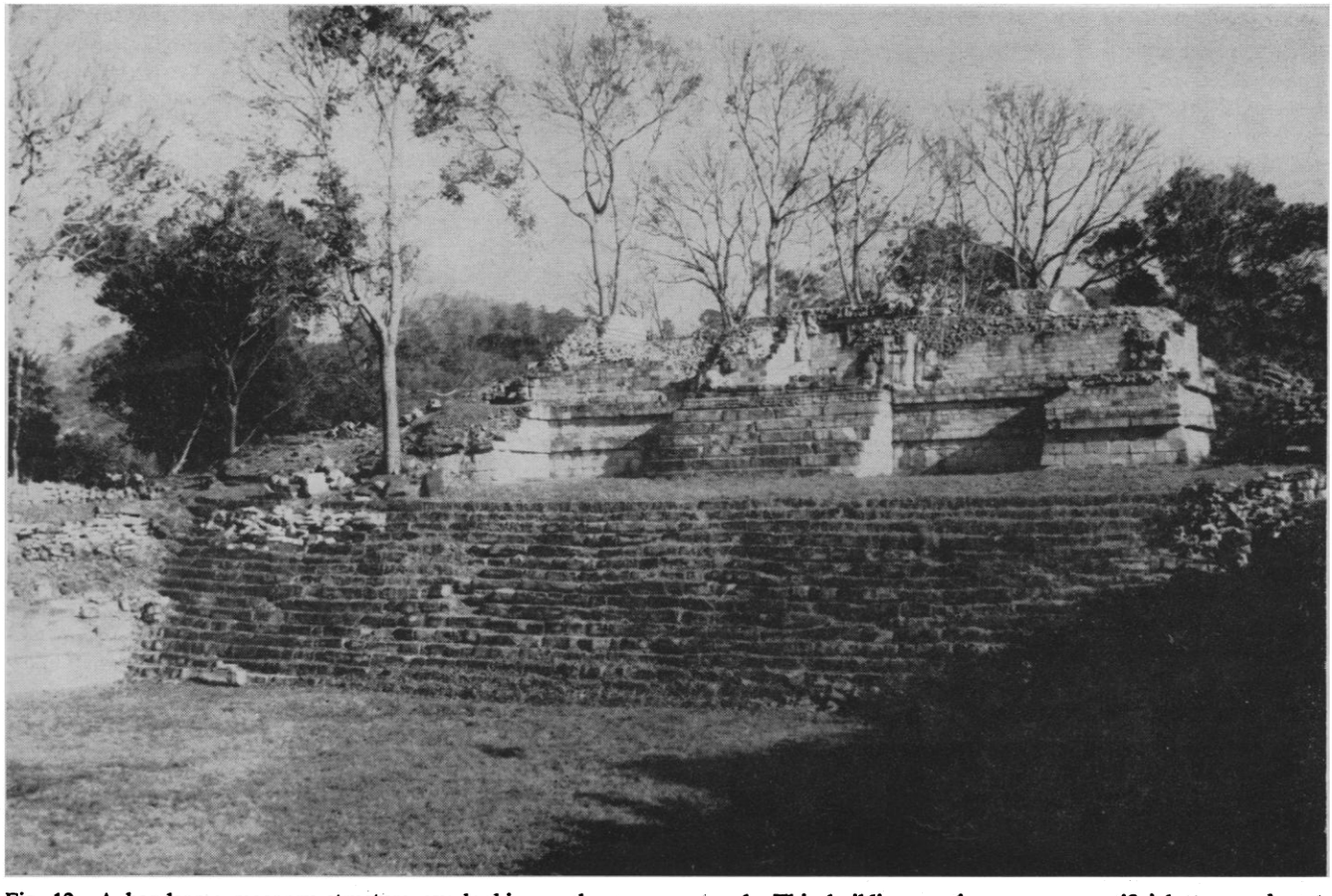

Fig. 12. A handsome masonry structure overlooking a plaza or courtyard. This building, resting upon an artificial terrace, is one of many at the Maya Classic period site of Copan in western Honduras. [Courtesy Carnegie Institution of Washington]

Fig. 13. A view of the great adobe wall bordering a side of one of the huge palace and living enclosures at the Peruvian north coast site of Chanchan. The ancient urban metropolis of Chanchan consists of several such enclosures. Chanchan was in its heyday in the 15th century, as the capital of the Chimu kingdom. It was taken over and destroyed by the Inca armies about A.D. 1470. [Courtesy Clifford Evans, Jr.]

historic southwestern United States relate to the Nuclear American zone. Development of these towns dates from sometime after A.D. 500, with an apogee in the Pueblo III and IV periods and in the Classic Hohokam phases (*71*).

On the other great periphery of Nuclear America, eastern North America, Middle American town life, with its temple mound-and-plaza complex, entered the Mississippi Valley sometime between A.D. 500 and 1000 and climaxed in the Mississippian or Temple Mound cultures shortly afterwards (*72*). Maize cultivation was an established part of this complex. Thus, in a sense, the thresholds of village farming and of the town-and-temple complex in the eastern woodlands, when these beginnings can be identified indisputably as of Nuclear American inspiration, are synchronous (Fig. 3).

There remains, however, as in our consideration of the village-farming level, the puzzle of the Adena-Hopewell cultures. As we have already noted, the Adena-Hopewell ceremonial mounds and earthworks, built between 800 B.C. and A.D. 200, are of impressive size. Some of them are comparable in dimensions, and in the amount of coordinated manpower necessary to build them, with the contemporary mounds of Middle America. Although the mounds of Middle America were usually temple platforms while the Adena-Hopewell tumuli were mounds heaped up to cover tombs and sacred buildings, this dichotomy should not be overstressed. Some mounds of Middle America also were tombs, or combined tombs and temples (*73*). In any event, it is safe to conclude that the Adena-Hopewell mounds were structures which memorialized social and religious traditions and served as community nuclei, as the ceremonial building did in Middle America. Was there a historical connection between Middle America and the Eastern Woodlands at this time, and was Adena-Hopewell ceremonial construction influenced by the emergence of the town-and-temple concept of Middle America? There is no satisfactory answer at present, but the possibilities cannot be dismissed (see Fig. 3).

In Nuclear America the city developed from the town and temple, and there is no sharp division between the two. Size is, assuredly, one criterion but not the only one. These cities were the nerve centers of civilizations. They were distinguished by great public buildings and the arts. Formal pantheons of deities were worshipped in the temples under the tutelage of organized priesthoods. Populations were divided into social classes. Trade, in both raw materials and luxury items, was carried on in these cities, and science and writing were under the patronage of the leaders (*74*). Not all of these criteria are known or can be inferred for any one city in the New World, but many of them do properly pertain to Middle American and Peruvian sites from as early as the first centuries of the Christian Era.

Cities in the New World seem to have been of two types, and these types may have their antecedents in the earlier dispersed and concentrated towns. The dispersed city, with its ceremonial center and outlying hamlets, appears to have been orthogenetic in its traditions and to have drawn upon, and commanded, a relatively limited geographical territory. The great lowland Mayan centers of the Classic period, such as Tikal or Palenque, are representative (*75*). The concentrated city adheres more to the concept of the city in the western European definition of the term. It was a truly urban agglomeration. Its traditions were heterogenetic, and its power extended over a relatively large territorial domain. The city was, in effect, the capital of an empire. Peruvian Chanchan, Aztec Tenochtitlan, and, probably, the more ancient Mexican city of Teotihuacan represent the type (*76*).

Although the cities and civilizations which developed in Middle America and Peru in the 1st millennium A.D. were unique and distinct entities in their own right, it is obvious that they also drew upon a common heritage of culture which had begun to be shared by all of Nuclear America at the level of village-farming life. This heritage was apparently built up over the centuries, through bonds of interchange and contact, direct and indirect. There are substantial archeological evidences in support of this supposition (*77*). During the era of city life these relationships continued, so that a kind of cosmopolitanism, resulting from trade, was just beginning to appear in Nuclear America in the last few centuries before Columbus.

In the outlands beyond Nuclear America, trade and influences from the cities followed old routes of contact and penetrated and were assimilated in varying degrees. In the south Andes there was the very direct impact of the Inca state in the final hundred years before the Spanish conquest (*70*), and northward from Mexico, Toltec-derived influences reached the North American Southwest in relatively unadulterated form (*78*). But, for the most part, the potentialities of the New World city for influencing and acculturating the "barbarian outlanders" were still unrealized when the Europeans entered the American continents.

Comments

Conclusions are inappropriate to a synthesis which, by its nature, is an outline of opinion, however tentative. Retrospective comment seems more in order.

A few things stand out. The early inhabitants of the New World were not remarkably different in their mode of life from the food gatherers and hunters of the Old World; yet even on these early horizons, and despite the relatively limited cultural inventories available, dissimilarities of form are striking. The interrelationships of the two hemispheres during the Pleistocene are still very vague.

Plant cultivation in the New World—its incipient rise and its culmination as the most effective subsistence base of the Americas—is, of course, analogous to happenings in the Old World. The important American plants, however, are of local origin. In the Western Hemisphere the incipience of cultivation followed the end of the Pleistocene, and was not a great deal later, perhaps, than in the Old World Middle East. Yet the period of incipience was longer here; over 5000 years elapsed before village life was sustained by crop cultivation. Is this because the first New World cultigens were inadequate as foodstuffs, and it was necessary to develop, first, the cereal maize before agriculture was made profitable?

Although there is a high correlation between village life and agricultural subsistence in the New World, there were New World societies and cultures which maintained villages without plant cultivation. In at least one instance, that of the ancient Adena-Hopewell development of eastern North America, community centers comparable to those of the contemporary farmers of Middle America may have been built and supported without a full-fledged farming subsistence.

I have slighted in this presentation the relationships between Asia and the Americas which were probably maintained from Pleistocene times down to the European conquest. This is particularly true of the cultures of the northern half of North America, where it is certain that there were contacts between the Old World and the arctic, subarctic, and northwest Pacific coasts. For Nuclear America nothing at all has been said of the possibility of trans-Pacific contacts between the Old World civilizations of China and Southeast Asia and those of Middle America and Peru. This undoubtedly reflects my own bias, but I remain willing to be convinced of such events and their importance to the history of culture in the New World.

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64. See J. B. Griffin, *"The Chronological Position of the Hopewellian Culture in the Eastern United States," Univ. of Michigan Museum of Anthropol., Anthropol. Paper No. 12* (1958), for a résumé and analysis of Adena and Hopewell radiocarbon dates.
65. J. A. Ford and C. H. Webb, "Poverty Point: A Late Archaic site in Louisiana," *Am. Museum Nat. Hist., Anthropol. Paper No. 46* (1956), pt. 1.
66. R. Wauchope [*Middle American Research Records* (Tulane University, New Orleans, La., 1950), vol. 1, No. 14] states the case for an early village-farming level without ceremonial mounds or constructions. While it is true that in some regions of Middle America the temple mound is absent in the earlier part of the "Formative" or "Preclassic" period, it is not clear that such a horizon prevails throughout all of Middle America. In fact, recent data [see M. D. Coe (*56*)] suggest that temple mounds were present in southern Middle America at the very beginnings of village farming.
67. See R. K. Beardsley, B. J. Meggers *et al.*, in "Seminars in Archaeology: 1955," *Soc. Am. Archaeol. Mem. No. 11* (1956), pp. 143-145, for discussion of an "advanced nuclear centered community."
68. It is possible that such a ceremonial center as San Agustín, such in southern Colombia, was, in effect, a town with concentrated ceremonial components and, probably, scattered hamlet-sustaining populations. San Agustín has not been satisfactorily dated, but estimates have been made which would place it as comparable in age to town-temple centers in Middle America and Peru. See W. C. Bennett, "Archaeological Regions of Colombia: A Ceramic Survey," *Yale Univ. Publs. in Anthropol.* **30,** 109 (1944).
69. The town life of the Caribbean regions of Colombia and Venezuela at the period of the Spanish conquest is described by J. H. Steward in "Handbook of South American Indians," *Bur. Am. Ethnol., Smithsonian Inst. Publ.* (1949), vol. 5, pp. 718 ff.
70. See W. C. Bennett, E. F. Bleiler, F. H. Sommer, "Northwest Argentine Archaeology," *Yale Univ. Publs. in Anthropol.* **38,** 31 (1948).
71. See H. M. Wormington, "Prehistoric Indians of the Southwest," *Denver Museum Nat. Hist., Popular Ser. No. 7* (1947), pp. 76-102, 107-147.
72. J. B. Griffin [*Archaeology of Eastern United States* (Univ. of Chicago Press, 1952), Fig. 205] estimates these events at about A.D. 900 to 1000. There are indications from some parts of the southeastern United States that temple mounds are much older. For example, see H. P. Newell and A. D. Krieger, "The George C. Davis Site Cherokee County, Texas," *Soc. Am. Archaeol. Mem. No. 5* (1949), and R. P. Bullen, *Florida Anthropologist* **9,** 931 (1956), for a radiocarbon date (about A.D. 350) on the Kolomoki culture.
73. See W. R. Wedel, in P. Drucker, "La Venta, Tabasco, A Study of Olmec Ceramics and Art," *Bur. Am. Ethnol. Smithsonian Inst. Bull. No. 153* (1952), pp. 61-65, for a description of a stone-columned tomb within an earth mound at La Venta. In this connection, the stone tombs covered by earth mounds at San Agustín, Colombia, as described by K. T. Preuss, *Arte monumental prehistoric* (Escuelas Salesianas de Tipografia y Fotograbado, Bogotá 1931), may be pertinent.
74. See V. G. Childe's criteria of city life in *Town Planning Rev.* **21,** 3 (1950).
75. Such centers, although serving as foci for the achievements of civilization, continue more in the form and in the homogeneous traditions of the Beardsley, Meggers *et al.*, "advanced nuclear centered community" (*67*).
76. This kind of city, a "true" city in a modern western European sense, corresponds more closely to what Beardsley, Meggers *et al.* call "supra-nuclear integrated" communities (*67*, pp. 145-146).
77. G. R. Willey, *Am. Anthropologist* **57,** 571 (1955), and in *New Interpretations of Aboriginal American Culture History* (Anthropological Society of Washington, Washington, D.C., 1955), pp. 28-45; see also, S. F. de Borhegyi, *Middle American Research Records* (Tulane University, New Orleans, La., 1959), vol. 2, No. 6.
78. Such features as Middle America-derived ballcourts and the casting of copper ornaments are well known in Hohokam archeology [see Wormington (*71*)].

The Great Fireball of 26 July 1938

A strongly hyperbolic orbit is derived for this body, indicating an origin outside the solar system.

Charles P. Olivier

At 9:02 P.M., E.S.T., on 26 July 1938, a great bolide or exploded fireball started over eastern Pennsylvania and, moving in a general northeast direction, ended over southern Vermont. It passed to the west of New York City, and its greatest brilliance, due to several explosions or flares, occurred to the north of that city; hence, comparatively few persons much to the south had their attention called to it. Further, few stars were readily visible, due both to the early hour and to scattered clouds or haze over some regions. Three persons at once began to gather data; C. A. Federer, then at the Hayden Planetarium, New York City; C. H. Smith at Waterloo, N.Y., who was the regional director for the American Meteor Society, and F. G. Watson at Harvard Observatory, Cambridge, Mass. All three began solutions based upon the data in their hands, and in fact Smith actually computed a preliminary atmospheric path, but after some time, as the number of reports was so great, all three men decided to send what was in their hands to me for a final solution. At an estimate, about 800 reports came in—far the largest number ever received by me on one fireball. Work was started, then delayed, and the same thing happened several times, but at last I have taken time to make as complete a solution as seems possible, and the results appear in this article.

The author is former director of the Flower and Cook Observatories, University of Pennsylvania, Philadelphia.

Finding the Path

The solution of paths and orbits of fireballs is of course of scientific interest and furnishes important data about our atmosphere and also enables one to form hypotheses dealing with their place and manner of origin. I have computed and published about 100 of them in the past, but for reasons to be